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REMARKS

Claims 1 - 6 and 10 - 21 of the application are pending. The rejections of record are addressed below in the order presented in the Office Action. Reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Rejections Under 35 U.S.C. §112

Claim 20 stands rejected under 35 U.S.C. §112, first paragraph. Claim 20 has been amended to overcome the 35 U.S.C. §112, first paragraph rejection. Claims 16 - 18 and 20 stand rejected under 35 U.S.C. §112, second paragraph. Claims 16 - 18 and 20 have been amended to overcome the 35 U.S.C. §112, second paragraph rejections.

Rejections Under 35 U.S.C. §102 in view of JP '785

Claims 1, 2, 6, 10-13, 15-17, 20, and 21 stand rejected under 35 U.S.C. §102(b) as anticipated by JP '785. JP '785 discloses an electrochemical cell comprising opposed positive and negative electrodes and an electrolyte in ionic contact with the electrodes. Stearic acid or a salt thereof is added to the electrode paste prior to forming the negative electrode, forming a fatty acid film on an active material surface of the electrode.

The Office Action states that JP '785 includes a current impeding medium. Although it may be correct to state that the current is reduced by the presence of the fatty acid present in the electrode, it is not correct to state that it operates as a current impeding medium. The abstract of JP '785 describes the effect of the fatty acid film, which can be broken down into the following sequence.

(1) Using a negative electrode activation material (2) a fatty acid film is formed on an active material surface, (3) thereby raising the hydrogen overvoltage and (4) reducing a charge current for constant voltage charge. As a consequence (5) the hydrogen generating reaction is suppressed during overcharging and (6) the liquid losing characteristic is improved.

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In terms of this sequence, it is clear that the fatty acid film acts to raise the hydrogen overvoltage i.e. the potential at which, in the absence of the fatty acid, electrolysis would take place to generate hydrogen. It does not create a resistive path in the flow of current to the negative electrode, as is the case in the present invention.

The sequence steps 2 to 5 are also confirmed if one has regard to the proper interpretation of paragraph (013) of JP '785, i.e. that by forming a coat of a fatty acid in an active material front face the hydrogen overvoltage goes up. As a consequence, the charging current in (sic) constant-potential charge is reduced. In view thereof, in the words of the inventors of JP '785, "it is made hard to happen the hydrogen generating reaction under overcharge". As a consequence, this property is improved by addition of the fatty acid to a negative electrode active material. Accordingly, the current is reduced at a constant potential due to the raising of the hydrogen overvoltage, and not because the coat/film provides an impediment to the flow of current between the electrodes. The inventor of the present invention has carried out comparative tests using fatty acids and has confirmed the mechanism of raising the hydrogen overvoltage after several hours of receiving a charge.

Inclusion of fatty acid leads to a fatty acid film on the active material surface. This film raises the hydrogen overvoltage. Then, when a battery with a raised hydrogen overvoltage is connected to a constant voltage charge, the current requirement of the battery will go down, there being a smaller potential difference between the charger and the battery. The charge current will therefore be reduced. According to the specification of JP '785, the battery is in a condition of "overcharge", therefore practically all of the current will go towards electrolysis – i.e. the generation of gas, for example, hydrogen gas. According to Faraday's Law, a reduction in this current must bring about a reduction in the hydrogen generation. This sequence runs exactly in accordance with the sequence as discussed above.

Further, based on the abstract, the Office Action states that hydrogen is generated by the cell, which is indicative that a potential sufficient to cause electrolysis is applied to the cell. Once again, whilst it is correct that the cell in JP '785 is subjected to an "overvoltage", the "hydrogen generating reaction is suppressed during overcharge". According to The Concise

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Oxford Dictionary (British) and The World Book Dictionary (American), to suppress means "to put an end to, stop by force, put down, quell, or put an end to activity or existence of". It is clear that the inventors of JP '785 have attempted to prevent hydrogen generation, and not merely reduce it. Once again this is consistent with paragraph (013) where it is stated that "it is made hard to happen the hydrogen generating reaction under overcharge". By raising the hydrogen overvoltage or potential threshold above that at which electrolysis would ordinarily take place, any such electrolysis is greatly reduced if not completely prevented such that the battery "loses little amount of liquid".

Claim 1, as pending, is distinguished from JP '785 based on the arguments above, particularly because of the inclusion of a current impeding medium that provides "a resistive path in a flow of a current between the electrodes", which is not disclosed in JP '785.

Claim 1 has nevertheless been further amended to distinguish it further over the JP '785 reference. In this regard, claim 1 has been amended to specify two modes, one relating to the normal charging cycle and the other relating to the phase during which an "overvoltage" is applied to the cell, and specifying that the current impeding medium is active in the latter phase only.

The presence of the fatty acid in JP '785 means that it is active throughout the charging phase by raising the hydrogen overvoltage. This is confirmed in the abstract where the inventors of JP '785 state that there is a drop in the efficiency of the cell upon addition of the fatty acid and greatly so when it exceeds 2%. By contrast, because the current impeding medium of the present invention is inactive during the charging phase, it has no negative effect on this phase of operation of the cell. In view thereof, it is respectfully submitted that claim 1, as amended, is structurally distinguished over JP '785.

Referring to claim 2, the Office Action states that a fatty acid film is an example of a non-ionic compound. It is believed that the Office Action is incorrect in this and that stearic acid and its salt are both anionic. Claim 2 has been amended to specify that where the current impeding medium is anionic, it must be provided in the presence of a suitable cation to attract it to the negative electrode. There is no such disclosure in JP '785.

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The Office Action has raised similar arguments against claim 6 as were raised against claim 1. Once again, although the inventor respectfully does not agree with the Office Action's view that the fatty acid is a current impeding medium as specified in claim 6, claim 6 has been further amended to distinguish it from JP '785. In this regard, the amended claim makes it clear that the current impeding medium forms a resistive path only when active in the second mode of the cell in which it is receiving an overpotential or overcharge. This "snap-on" / "snap-off" effect, at the threshold potential of the cell, as illustrated in Figure 3, of the present application, is clearly disclosed in the JP '785 cell.

Claims 10 and 12 stand rejected on the basis that the fatty acid forms an impediment or barrier over a surface of the negative electrode when a sufficient potential is applied across the electrodes to cause electrolysis of the electrolyte. The Office Action clearly equates "film" or "coat", which appear to be used interchangeably in JP '785, with a barrier or impediment. Once again, with respect, the inventor believes that the Office Action's assumption that the film equates to a barrier is not supported by the text of JP '785.

As previously mentioned, the "film" in JP '785 is present on the negative electrode as an activation material to raise the overvoltage of the electrode. Further, the kneading process of manufacturing the negative electrode discussed in JP '785 (paragraph 008, Example 1) makes it difficult to see how a film is formed directly over the surface of the electrode. The text of JP '785 does not assist in this. However, references such as *Electrochemistry*, by Hamman C.H., *et al*, Wiley-VCH Verlag GmbH, ISBN 3-527-29095-8 and *Fundamentals of Electrochemical Deposition*, by Paunovic, M. and Schlesinger, M, John Wiley & Sons Inc, ISBN 0-471-16820-3, provide ample examples of the formation of films on the surfaces of electrodes. According to these references, sparingly soluble compounds, such as stearic acid (JP '785 refers to it as "hardly" soluble), may become partially solvated upon operation of the battery, forming a layer or layers similar to that depicted in Figure 3-17 of *Electrochemistry* page 101, attached as **Annexure A**. This is believed to explain the "film" reported in JP '785.

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Further, because of the negatively charged RCOO^- group of the stearic acid or its salt, it will not be attracted to the negative electrode, but would more likely diffuse through the electrolyte. Accordingly, it is submitted that the film of JP '785 is not a barrier or impediment to the flow of current or ions to the electrode or gas bubbles from the electrode. Rather it is what the inventors of JP '785 say it is, a film that activates the negative electrode. Once again, a review of the abovementioned references provides a description of a potential gradient in the layer (film) as discussed in JP '785, which it is believed accounts for the increase in the hydrogen overvoltage of the negative electrode. In this regard, see **Annexure B**. Although the electrode depicted is positive, an analogous potential gradient is to be found at a negative electrode.

In view of the remarks above, it is respectfully submitted that claims 10 (and dependent claim 11) and 12 (and dependent claim 13) are not anticipated by JP '785.

Claim 15 stands rejected. It is believed that claim 15 is now acceptable in view of the amendment to claim 1.

Claim 16 stands rejected. The Office Action has stated that 0.5 – 1% stearic acid does not negatively affect the cycling of the cell, as applied to claim 16. With respect, the abstract of JP '785 states that "[a] drop in the discharge capacity ... particularly increases according to an increase in the amount of fatty acid and greatly increases when the added amount exceeds 2%". Thus, the amount is kept between 0.5 to 1% to achieve a reduction in water loss, but with an associated decrease in discharge capacity. At amounts greater than 2% the cell simply chokes. As previously stated, the inventor has tested fatty acids in batteries and has identified a reduction in the discharge capacity. Thus, the invention, as recited in claim 16 is not anticipated by JP '785.

With regard to claim 17, whilst the fatty acid film may have better cycling performance when using less than 1% stearic acid than when using greater than 1% stearic acid, that does not equate to improving the cycling performance of the battery over a battery having no fatty acid additive. Once again, the inclusion of stearic acid, at levels of 0.5 to 1%, results in a drop in the discharge capacity of the cell.

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Claim 20 stands rejected. Claim 20 is dependent upon claim 12. In view of the arguments above, claim 12 has been shown to be novel over JP '785. Therefore, dependent claim 20 is also novel over JP '785.

Claim 21 stands rejected. Claim 21 is dependent upon claim 1, which has been amended and is novel over JP '785. Therefore, claim 21 is also novel over JP '785.

In view of the above, it is submitted that JP '785 does not anticipate the claims of the invention, as amended.

Rejections Under 35 U.S.C. §102 in view of JP '728

Claims 1 - 6, and 10 - 21 stand rejected under 35 U.S.C. §102(b) as anticipated by JP '728. JP '728 discloses an alkaline battery having opposed positive and negative electrodes with an aqueous electrolyte in ionic contact with the electrodes. A benzyl group containing quaternary ammonium salt is added to the anode active mass and/or the electrolyte to improve the charging and discharging characteristics of the alkaline battery.

By phone call of October 28, 2002, the Applicant requested a translation of the reference from the Examiner. The Examiner advised that no translation was available and that all rejections were based upon the abstract and further based upon numerical ranges on page 142 of the reference. In view thereof, it is difficult to see how the Office Action can once again state that dodecyl dimethyl benzyl ammonium chloride is included as a current impeding medium. The abstract states that a benzyl group containing quaternary ammonium salt is added to the anode active mass and/or the electrolyte in alkaline batteries, which improves the charging and discharging characteristics of batteries and extends their service life. For example, 3% dodecyl dimethyl benzyl ammonium chloride was added to a Ni-Zn alkaline battery electrolyte (30% KOH). As has previously been described, nickel-zinc batteries are problematic, as is evident from the following extract from the Handbook of Batteries, Linden, D, 2nd edition, McGraw-Hill, Inc., ISBN 0-07-037921-1, page 29-5:

"Zinc electrode problems manifest themselves during repeated cycling due to the partial solubility of the discharge product in the electrolyte. A portion of the discharge product dissolves during discharge in limited-electrolyte cells and

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redeposits back on the electrode structure on charge. Due to a number of effects (thermal, concentration gradients, current density distribution, and electrolyte inventory variations), the dissolution and redeposition processes are not mirrored. As the cycling proceeds in normal prismatic, limited electrolyte cells, this nonuniformity has the net effect of moving active material from the electrode edges toward the center, as shown in Fig. 29.2. For static-electrolyte cell designs, a number of approaches are currently under investigation to reduce the extent of this material redistribution. Such approaches include the complexing of the zinc reaction product with an additive such as calcium hydroxide to limit the zinc from going into solution, additives to the electrolyte to reduce the solubility of zinc in the electrolyte, and inert additives to the zinc electrode to create an electrode substructure for more uniform redeposition of zinc from solution.

Independent of the material redistribution problems, the zinc electrode can also be subject to a dendrite problem. At critical current densities and zincate concentration levels, the zinc redeposited on charge can grow in a needlelike dendrites. These dendrites have a tendency to grow toward the counterelectrode and can penetrate the separator, causing cell short-circuiting. The dendrite-forming process can be managed by additives to the electrolyte that have plating levelling effects, the use of membrane-type separator materials to retard zinc dendrite penetration, and controlled-charging techniques that minimize the occurrence of the critical zincate concentration and current density."

It is submitted that dodecyl dimethyl benzyl ammonium chloride is included in JP '728 to manage the dendrite-forming process. In view thereof, it is respectfully submitted that the previous submitted arguments submitted in support of the claims should have been persuasive.

It is noted that whilst paragraph 12 on page 10 of the Official Action relates to rejection of the claims in view of JP '728, the Office Action appears to be referring to JP '785 from the 3rd paragraph on page 12 to the end of the "Claim rejection" section on page 14, and again from the 3rd paragraph on page 16 to the end of the "Response to arguments" section on page 17. It would seem that the Office Action has interchanged and combined the subject matter of the JP '728 and JP '785 references to support the rejections under JP '728, which is clearly improper under a 35 U.S.C. §102(b) rejection.

In view of the above, it is reiterated that JP '728 provides no teaching or suggestion that dodecyl dimethyl benzyl ammonium chloride can be included in an electrochemical cell to provide a resistive path to the flow of current between the electrodes or as a barrier or impediment to the flow of current or ions to the negative electrode and gas bubbles from the

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negative electrode. Further, there is no teaching or suggestion that an additive can be included in an electrochemical cell which is inactive during the normal charging phase of the cell, but is active in the so-called "overpotential" or "overcharge" phase of the cell.

It is respectfully submitted that the claims are structurally and operationally distinguishable over JP '728.

Rejections Under 35 U.S.C. §102 in view of Davis '993

Claims 1, 2, and 12 - 21 stand rejected under 35 U.S.C. §102(b) as anticipated by Davis '993.

Applicant submits that the Office Action has erroneously equated the five specific polymerized quaternary salts specified in Davis with a current impeding medium. Further, Applicant submits that the Office Action erroneously concludes that because hydrogen is produced, it is indicative of electrolysis.

In the paragraph under "2. Description of Prior Art" (column 1, lines 15 to 16) it is stated that "a byproduct of the reaction of zinc with water is hydrogen". Thus, any hydrogen generated is due to this local action (See column 2, line 4), and not electrolysis. This local action is addressed by including in the LeClanche cell one of the specified agents which reduces the loss of cell capacity with cell age by reducing this local action. There is no description of the reduction of electrolysis through the use of a current impeding medium or barrier. This is not surprising, as LeClanche cells are primary cells that are not rechargeable. There are thus no repeated charging and discharging cycles. Accordingly, there is no repeated "overcharging" with accompanying water loss due to electrolysis.

Further, the Office Action refers on page 17, under paragraph 14, to "hydrogen generation is suppressed and the current is reduced by the presence of the fatty acid film...". The Office Action appears to be borrowing subject matter from JP '785 to substantiate these rejections. The combination of references in a 102(b) rejection is improper and withdrawal of the rejection is requested.

In view of the above, it is submitted that not only the process claims, but also the apparatus claims of the present invention, are distinguished over Davis.

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Additional Claims

Claims 22 - 29 have been added to further clarify the invented electrochemical cell.

Conclusion

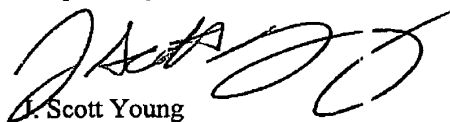
None of the prior art documents relied upon by the Office Action teach, suggest or even hint at the use of a current reducing medium that, when in contact with the electrolyte, forms a resistive path or barrier between the electrodes to a flow of current or ions to the negative electrode, or gas bubbles away from the electrode. Further, none of the references teach that an additive can be used in an electrochemical cell which is inactive during the normal charge and discharge phases of the cell, but which is active during the "overcharge" phase of the cell. In this regard, none of the references demonstrate an identifiable inflection point or threshold, as demonstrated in Figure 3, at which the additive goes from being inactive to active, and vice versa. Further, none of the documents provides a mechanism whereby the electrolytic process itself is manipulated in such a way as to reduce the electrolysis in a self-regulating manner. In summary, Applicant submits the invention, as recited in the claims, is both novel and non-obvious in view of the cited references.

The rejections set forth in the Office Action having been addressed in full, it is respectfully submitted that this application is in condition for allowance, which action is respectfully requested. It is not believed that extensions of time or fees for next addition of claims are required, beyond those, which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 C.F.R. § 1.136(a), and

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any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,


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Version with Markings to Show Changes Made:

1. (Twice Amended) An electrochemical cell comprising opposed positive and negative electrodes and an aqueous electrolyte in ionic contact with the electrodes, the electrochemical cell [being disposed to cause electrolysis when a sufficient amount of a potential is applied across the electrodes] having a first mode wherein the cell undergoes a charging reaction and a second mode wherein the cell undergoes an electrolysis reaction, the electrochemical cell further comprising a current impeding medium that [provides through contact with the electrolyte] is characterised as being substantially inactive during the first mode of the cell and active during the second mode of the cell, the current impeding medium when active creating a resistive path in a flow of a current between the electrodes [when a potential sufficient to cause electrolysis of the electrolyte is applied across the electrodes], thereby to reduce the flow of the current between the electrodes and consequently reducing the amount of electrolysis.

2. (Twice Amended) An electrochemical cell according to claim 1, wherein the current impeding medium is [selected from the group comprising] a quaternary ammonium compound[s] [including] selected from the group comprising n-alkyl dimethyl benzyl ammonium chloride, didecyl dimethyl ammonium chloride, didecyl methyl oxyethyl ammonium propionate, pyridine and quinoline, a non-ionic compound[s] [including] selected from the group comprising primary, secondary, [and] tertiary, aliphatic and cycloaliphatic amines, [and] or an anionic compound[s] [including sodium dioctyl sulpho succinate, the anionic compounds being included in the presence of suitable cations] which is provided in the presence of a suitable cation to attract it to the negative electrode.

6. (Twice Amended) A method of reducing water loss in an electrochemical cell of the type having opposed positive and negative electrodes, [and] an electrolyte in ionic contact with the electrodes, and [being disposed to cause electrolysis of the electrolyte when a sufficient amount of a potential is applied across the electrodes] having a first mode wherein the cell undergoes a charging reaction and a second mode wherein the cell undergoes an electrolysis

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reaction, the method including the steps of introducing into the cell a current impeding medium that [provides] is inactive during the first mode of the cell and active during the second mode of the cell, the current impeding medium when active providing through contact with the electrolyte a resistive path in a flow of a current between the electrodes [when a potential sufficient], and applying sufficient potential across the electrodes to cause electrolysis of the electrolyte [is applied across the electrodes, and applying sufficient potential to cause electrolysis of the electrolyte across the electrodes to activate the current impeding medium into providing] and to activate the current impeding medium into creating a resistive path to the flow of a current between the electrodes, thereby reducing electrolysis of the electrolyte.

10. (Twice Amended) A method according to claim 6, wherein the [current impeding medium additionally forms an impediment or barrier at the negative electrode] resistive path is formed as an impediment or barrier at the negative electrode to the flow of a current between the electrodes as well as to ions being attracted to the negative electrode or gas bubbles evolving from the negative electrode.

16. (Once Amended) An electrochemical cell according to claim [2]15, wherein the current impeding medium does not negatively affect a discharging cycle of the secondary battery cell.

17. (Once Amended) An electrochemical cell according to claim [2]15, wherein the current impeding medium provides an improved cycling performance of the secondary battery cell.

18. (Once Amended) An electrochemical cell according to claim [2]15, wherein the secondary battery cell has a threshold potential defining a boundary between the first and second modes of the secondary cell above which the current impeding medium reduces electrolysis of the electrolyte and below which the current impeding medium [does not negatively affect the operation of the secondary battery cell] is substantially inactive.

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20. (Once Amended) An electrochemical cell according to claim 12, wherein the impediment or barrier provides a reduction in the flow of ions [includes metal ions] selected from the group comprising lead, antimony, arsenic, tin, iron, zinc, chromium, copper and silver ions[, and other ions of metals conventionally used in lead-acid battery cells and other electrochemical cells].

21. (Once Amended) An electrochemical cell according to claim 1, wherein the current impeding medium is soluble and [in use is attached] attaches to the negative electrode to form the resistive path.

ANNEXURE "A"

3.4 The Electrolyte Double-layer and Electrokinetic Effects

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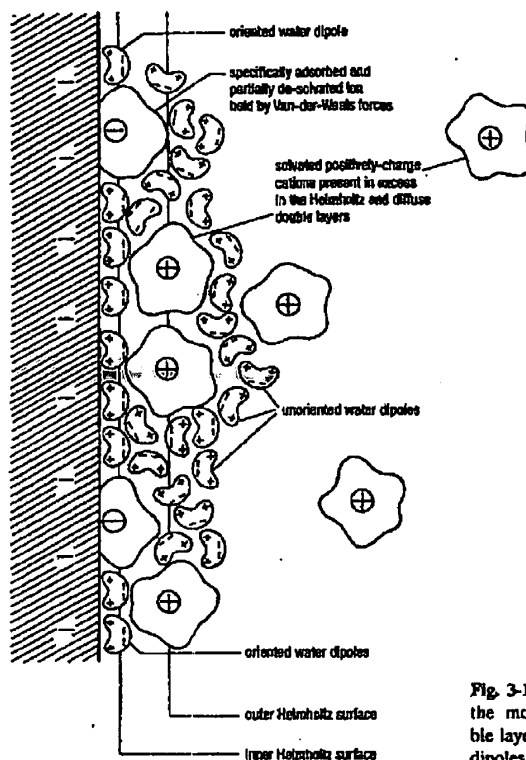


Fig. 3-17 Schematic representation of the molecular structure of the double layer showing both ions and water dipoles. See text for further discussion.

than cations gives rise, as stated above, to the existence of an *inner* Helmholtz plane. The final picture of the electrified double layer is given in Fig. 3-17, where the inner and outer Helmholtz planes are specifically indicated for a negatively charged electrode surface.

The potential of an electrode on whose surface there are no free excess charges, either specifically adsorbed ions or excess ions of either charge in the diffuse double layer, is termed its *potential of zero charge*, φ_{pzc} . In general, the value of φ_{pzc} is not identical to φ_s , the potential in the interior of the electrolyte, owing to the presence of solvent dipoles at the surface, which give rise to an unknown additional potential drop. The determination of φ_{pzc} is discussed in Section 3.4.5.

ANNEXURE "B"

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3 Electro Potentials and Double-Layer Structure at Phase Boundaries

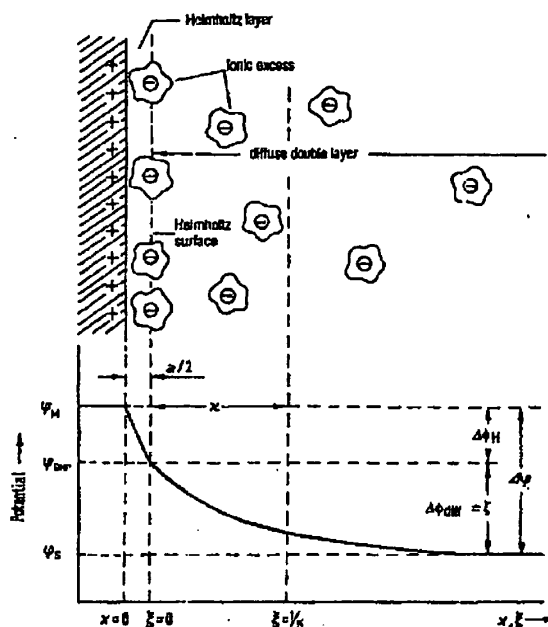


Fig. 3-16 Potential distribution at the general double layer: $\Delta\phi_H$ is the potential dropped in the Helmholtz layer and $\Delta\phi_{DL}$ that dropped in the diffuse layer. The zeta potential is numerically the same as $\Delta\phi_{DL}$.

3.4.2 Adsorption of Ions, Dipoles and Neutral Molecules - the Point of Zero Charge

Ions, solvent dipoles and neutral molecules with or without dipole character may be adsorbed on a metal electrode surface, either if they experience van der Waals interactions or if they experience Coulombic interactions with the charged surface. Clearly, in general, such adsorption may be weakened or strengthened by potential changes on the electrode, but since anions, in particular, have a tendency to undergo *specific* adsorption through van der Waals interactions, they can be adsorbed on an electrode surface even if it is negatively charged. For such anions, given that the solvent sheath must be stripped off, at least on the metal side of the anions, before specific adsorption can take place, it is a general rule that the weaker the solvation of the anion, the stronger will be its specific adsorption. The fact that anions may adsorb more closely